Thermal Diffusion Length and Migration Length

Diffusion coefficient, thermal diffusion length and migration length of a moderator or mixture from its scattering and absorption cross-sections and Fermi age.

Method: One-group neutron diffusion parameters

Input parameters

Unit system: SI

Parameter	Value	Unit
Macroscopic scattering cross-section	0.38500	1/cm
Macroscopic absorption cross-section	2.7300e-04	1/cm
Mass number of the scatterer	12.000	
Fermi age to thermal	368.00	cm²

Calculated results

Parameter	Value	Unit
Mean cosine of scattering 2/(3A)	0.055556	
Transport cross-section	0.36388	1/cm
Diffusion coefficient	0.91604	cm
Thermal diffusion length	57.926	cm
Migration length √(L² + τ)	61.020	cm
Transport mean free path	2.7481	cm

Notes for this case

• Σ_tr = Σ_a + Σ_s(1 − μ̄₀), D = 1/(3Σ_tr), L² = D/Σ_a, M² = L² + τ. For water or other molecules the mean cosine is not 2/(3A); use measured D values. Diffusion theory needs Σ_a ⍰ Σ_s.

Formula and method

$$\Sigma_{tr} = \Sigma_a + \Sigma_s(1 - \bar{\mu}_0), \quad D = \frac{1}{3\Sigma_{tr}}, \quad L^2 = \frac{D}{\Sigma_a}, \quad M^2 = L^2 + \tau$$

Variables

Σ_s	Macroscopic scattering cross-section	1/m
Σ_a	Macroscopic absorption cross-section	1/m
A	Mass number of the scatterer	-
τ_T	Fermi age to thermal	m²
$\bar{\mu}_0$	Mean cosine of scattering 2/(3A)	-
Σ_{tr}	Transport cross-section	1/m
D	Diffusion coefficient	m
L_T	Thermal diffusion length	m
M_T	Migration length √(L² + τ)	m
λ_{tr}	Transport mean free path	m

Method and standards

One-group diffusion parameters.

Assumptions and limits

- Weak absorber; isotropic scattering in the centre-of-mass frame.

References

One-group neutron diffusion parameters

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/nuclear-power/thermal-diffusion-length-migration

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.